HOW OCEAN-LAND FRACTION AND DISTRIBUTION AFFECTS HABITABLE CONDITIONS ON EARTH-LIKE PLANETS. Alejandro Soto[1], [1]Southwest Research Institute, Boulder, CO, USA; asoto@boulder.swri.edu.

Introduction: At the global and regional scale, the habitability of a terrestrial planet is dependent upon the ability of the climate system to sustain a vigorous hydrological cycle and to maintain relatively active precipitation over land [1, 2, 3]. Most previous investigations have focused on the planetary and stellar parameters required to create climate conditions that would meet these criteria for habitability; research has particularly focused on the parameters required to achieve global mean temperatures above the triple point of water, i.e., 273 K. However, the mere existence of surface liquid water on a terrestrial planet does not guarantee the global distribution of this water. For a given ocean-land fraction, there should be an associated 'habitable' fraction of the planet, but this relation between ocean-land fraction and habitable fraction remains under-explored. A planet with a small ocean-land fraction may be mostly dry. But is this true for all distributions of the oceans? At what ocean-land fraction does a planet transition to being mostly wet? As we continue to observe exoplanets, the answers to these questions will be critical to determining the extent of habitability. Our investigation works to address these questions.

Simulations: We use the Earth version of the Planet Weather Research and Forecasting (PlanetWRF) model, which was built to numerically simulate a wide range of terrestrial atmospheres. PlanetWRF is a modified version of the National Center for Atmospheric Research (NCAR) Weather Research and Forecasting (WRF) model, capable of mesoscale to global scale modeling of the atmospheric circulation [4]. PlanetWRF provides us with an array of robust surface physics schemes with which to simulate the hydrological environment.

Figure 1 shows the effect of the ocean-land fraction and distribution. This simulation has a 25% ocean-land fraction with a circular north polar ocean. We gave the north polar ocean a ragged coastline similar to the coastline of the putative paleo-ocean on Mar, but there is no topography in this simulation. As seen in Figure 1, the annual mean cloud activity is concentrated over the oceans, which is consistent with ocean surface heating by the sun leading to convection and cloud formation over the ocean. The bulk of the clouds remain confined in the polar region, apparently unable to mix equator-ward. In this type of configuration, any habitable environment dependent on regular access to liquid water will be constrained to the northern portion of the planet. It is possible that the bulk of this planet would remain a desert, both hydrologically and biologically. This simple test highlights the possible climate states due to the ocean-land fraction and distribution.

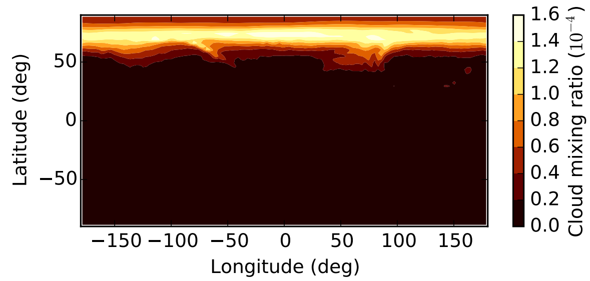

Figure 1: **A map of the annual mean cloud mass mixing ratio at ~700 mbar for a 25% ocean-land fraction simulation. The ocean is centered on the north pole. The simulation is an Earth-like planet in an Earth-like orbit around a G-type main sequence star like the Sun. The contours are for the mixing ratio of liquid water.**

Conclusion: We are investigating how ocean-land fraction and distribution affects the creation of habitable conditions on the surface of Earth-like exoplanets. Our simulations explore a range of ocean-land fractions as well as distributions, providing new insight into the extent of habitable conditions on Earth-like exoplanets.

References: [1] F. Franks (2000) *Water: a matrix of life* Royal Society of Chemistry, Cambridge, UK. [2] H. Lammer, et al. (2009) *The Astronomy and Astrophysics Review* 17(2):181 ISSN 0935-4956. [3] C. Cockell, et al. (2016) *Astrobiology* 16(1):89. [4] M. I. Richardson, et al. (2007) *Journal of Geophysical Research (Planets)* 112(E09001):9001.